Social expectations reverse the effects of acetaminophen on economic decision-making

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Abstract

On an average week, 23% of the US population takes acetaminophen (i.e. paracetamol; active ingredient in Tylenol; Kaufman, Kelly, Rosenberg, Anderson, & Mitchell, 2002). Originally viewed as just a physical pain killer, acetaminophen has been shown to affect other psychological processes (DeWall et al., 2010; DeWall, Chester, & White, 2015; Durso, Luttrell, & Way, 2015; Randles, Heine, & Santos, 2013). With such a large proportion of the population routinely taking acetaminophen, it is critical to know how it might affect social and economic outcomes. Here we used a battery of economic games to demonstrate that acetaminophen has consistent effects on decision-making, but the direction of acetaminophen's effect depends on whether the individual has high or low expectations. In a monetary investment game (i.e. trust game), acetaminophen increased investments from subjects with low expected returns from the trustee, but decreased investments from subjects with high expected returns. Next, in a negotiation game (i.e. ultimatum game), we used sequences of high and low monetary offers to exogenously manipulate the expectations of the responders. Acetaminophen increased the acceptance of relatively unfair offers and reduced the acceptance of relatively fair offers. Finally, acetaminophen also caused trustees in the trust game to be less influenced by their beliefs about how much the investors expected them to return. Thus, acetaminophen also reduced how beliefs about another's expectations drove reciprocity. Overall, our results demonstrate that acetaminophen has socially important but previously unrecognized dampening effects on how people respond to both financial incentives and disincentives for themselves and for others. Furthermore, our findings highlight what we believe to be a general

principle of drug action: that psychological factors can change the behavioral and perhaps clinical effects of drugs.

Social Expectations Reverse the Effects of Acetaminophen on Economic Decision-Making

On an average week, 23% of the US population takes acetaminophen (ie. paracetamol; the active ingredient in Tylenol; Kaufman et al., 2002). While people expect this over-the-counter painkiller to alleviate their physical discomforts, most never stop to consider whether the drug might have effects beyond the reduction of physical pain, much less that it could influence their social interactions and decisions. This sort of targeted effect has long been the general perception of acetaminophen and other medications among the lay public, scientists, and the companies who manufacture and sell them. However, recent research has begun to challenge this basic assumption.

Until recently, acetaminophen has been viewed as just a physical painkiller without any further psychological or behavioral effects. However, an accumulating body of work has now shown acetaminophen to affect general evaluative processes. For example, acetaminophen has been shown to reduce self-reports of hurt feelings and neural responses associated with experiences of social pain (DeWall et al., 2010). Other studies have also shown acetaminophen to dampen responses to other aversive experiences (DeWall et al., 2015; Randles et al., 2013). Most recently, acetaminophen has been shown to reduce evaluations of both negative and positive emotional images (Durso et al., 2015). Thus, there is emerging and consistent evidence that acetaminophen dampens both negative and positive evaluations in general. However, no research to date has examined whether acetaminophen impacts the economic decisions that people make in social interactions.

Models of economic and social choice highlight evaluation as a central process in decision-making (e.g., Rangel, Camerer, & Montague, 2008). Thus, if acetaminophen dampens

evaluations, it should influence the decisions that people make. However, when making decisions as part of a social interaction, people's evaluations and behaviors are critically shaped by their expectations of the other person's behaviors and beliefs (Chang & Sanfey, 2013; Chang, Smith, Dufwenberg, & Sanfey, 2011; Darley & Fazio, 1980; Delgado, Frank, & Phelps, 2005; Xiang, Lohrenz, & Montague, 2013). That is, a person's expectations about another's behaviors and beliefs can produce either positive or negative evaluations (e.g., will this interaction end positively or negatively?). Thus, because acetaminophen dampens both negative and positive evaluations (Durso et al., 2015), the direction of its effects on economic decision-making in a social interaction should critically depend on the individual's expectations. Here, we used a battery of economic games across two double-blind, placebo-controlled studies to test the hypotheses that (1) acetaminophen will impact social economic decision-making and (2) that the direction of acetaminophen's effect will critically depend on social expectations. In both studies, subjects received either 1000mg of acetaminophen or placebo, both in a liquid vehicle, and completed the critical tasks 1 hour after drug administration. Subjects were compensated based on one of their decisions, which was selected at random.

In study 1, we tested whether acetaminophen would interact with a person's expectations when deciding how much money to entrust to another person. One hundred twenty-two undergraduates at The Ohio State University played the role of investor in 4 one-shot trust games with anonymous partners. In each trust game, subjects were given a monetary endowment and allowed to send as much or as little as they liked to their partner. They were instructed that their investment would be multiplied by 4 and then given to their partner (the trustee) who would then decide how much to return to the investor. After making each

investment decision, subjects reported how much they expected the trustee to return. A linear mixed-effects regression revealed a significant interaction between drug condition and investor expectations on the amount invested (b = -0.162 (0.067), t = -2.417, p = 0.016). Further analysis, revealed that acetaminophen increased the amount invested when subjects had negative expectations (b = 0.184 (0.095), t = 1.947, p = 0.053) but decreased the amount invested when subjects had positive expectations (b = -0.145 (0.084), t = -1.736, p = 0.085; see Figure 1). Thus, acetaminophen affected trust behavior, but the direction of the effect was determined by the valence of the investor's expectations.

In study 2, we sought to extend our findings from study 1 by exogenously inducing positive or negative expectations in a negotiation game. One hundred nineteen undergraduates at The Ohio State University played the responder in several one-shot ultimatum games with anonymous partners. In each ultimatum game, a subject from another study (the proposer) proposed how to split a sum of money with the subject in the current study (the responder). If the responder accepted the offer, both players would be paid accordingly. If the responder rejected the offer, both players would receive nothing. The offers varied in fairness (i.e., proportion of total sum offered to the responder). Past work has shown that when completing repeated ultimatum games in sequence, the fairness of prior offers shapes responders' expectations and thus their rates of offer acceptance of subsequent offers (Xiang et al., 2013). For example, the same offer (e.g., 30% of the total sum) will be evaluated more positively or more negatively depending on whether the preceding offer either lowered expectations (e.g., 10% of the total sum) or raised expectations (e.g., 50% of the total sum), respectively. Therefore, we used trial-to-trial fluctuations in offer fairness to manipulate expectations. A

linear mixed-effects regression revealed an interaction between drug condition and changes in offer fairness (b = -0.364 (0.197), z = -1.844, p = 0.065; see Figure 2) such that subjects on acetaminophen were less sensitive to changes in offer fairness (b = 0.48 (0.156), z = 3.105, p = 0.002) relative to placebo (b = 0.849 (0.173), z = 4.9, p < 0.0001). Thus, acetaminophen, relative to placebo, increased acceptance of offers that showed a relative decrease in fairness and decreased acceptance of offers that showed a relative increase in fairness.

Finally, we aimed to test if acetaminophen would interact the perceptions of another person's expectations to influence behavior. To address this question, subjects in study 2 also played 32 one-shot trust games in the role of trustee (responding to investments from subjects in study 1). Past work has demonstrated that trustees frequently demonstrate guilt-aversion in that they will avoid violating what they think the investor expects them to return (Chang et al., 2011; Nihonsugi, Ihara, & Haruno, 2015). Thus, we asked subjects how much they thought their partner for each trust game expected them to return before deciding how much they would actually return (Chang et al., 2011). A linear mixed-effects regression revealed a significant interaction between drug condition and expectations (b = -0.092 (0.032), t = -2.897, p = .004; see Figure 3) such that subjects on acetaminophen were less sensitive to perceptions of expectations (b = 0.421 (0.023), t = 18.402, p < .0001) relative to placebo (b = 0.513 (0.022), t = 23.486, p < .0001). Furthermore, this effect was stronger among subjects high in shame proneness (b = -0.074 (0.02), t = -3.745, p < .0001), high in guilt proneness (b = -0.034 (0.02), t = -1.684, p = .092), high in measures of interpersonal sensitivity (i.e., need to belong: b = -0.16 (0.02), t = -8.137, p < .0001; rejection sensitivity: b = -0.094 (0.017), t = -5.433, p < .0001), and high in affective components of empathy (i.e., empathic concern: b = -0.077 (0.018), t = -4.216,

$p < .0001$; personal distress: $b = -0.09$ (0.02), $t = -4.532$, $p < .0001$) but not a more cognitive component of empathy (i.e., perspective taking: $b = -0.002$ (0.019), $t = -0.095$, $p = .925$). Furthermore, following completion of the trust games, subjects were presented with recaps of a subset of their decisions and asked how much guilt they would feel if they had returned a randomly generated alternative amount (i.e., counterfactual guilt; Chang et al., 2011). Results revealed an interaction between drug condition and how much less the generated alternative was compared to the actual amount they returned ($b = -0.085$ (0.048), $t = -1.786$, $p = .075$; see Figure 4 and Table 14) such that subjects on acetaminophen showed reduced guilt sensitivity ($b = 0.446$ (0.046), $t = 9.597$, $p < .0001$) relative to placebo ($b = 0.531$ (0.048), $t = 11.033$, $p < .0001$). Thus, acetaminophen, relative to placebo, reduced how sensitive trustees were to their perceptions of investor expectations. Furthermore, this effect was strongest among subjects who self-reported high sensitivity to affective stimuli.

Across a battery of tasks, the results revealed novel and consistent effects of acetaminophen of social economic decision-making that critically depended on the subjects' social expectations. In two of the tasks, the subject's expectations reversed the effects that acetaminophen had relative to placebo on trusting behavior and responses to fairness. The third task revealed that acetaminophen reduced how much subjects used their own perceptions of their partners' expectations when making decisions about reciprocating trust.

The current results reveal important insights for both basic and applied research. First, given the large proportion of the population that takes acetaminophen each week, acetaminophen may be having large-scale, unexpected impacts on people's social and economic decision-making. Understanding the nature and magnitude of these effects is an

important topic for future research. Second, we believe that our data demonstrate what we consider to be a general principle of drug action: that psychological factors can change the behavioral and perhaps clinical effects of drugs. Further research adopting this perspective may help to shed new light on controversies and inconsistencies that are presently found in the basic pharmacological and clinical literatures (e.g., anti-depressants sometimes increasing suicide risk; see Hammad, Laughren, & Racoosin, 2006; Miller, Swanson, Azrael, Pate, & Stürmer, 2014; Stone et al., 2009).

SUPPLEMENTARY MATERIALS

Study 1 and 2 are described in more detail below.

Study 1

One hundred twenty two undergraduates at The Ohio State University completed the experiment in exchange for course credit. Subjects were randomly assigned to take either an acute dose of 1,000 mg of acetaminophen or a placebo, both in a liquid vehicle (61 in each condition). Experimenters and subjects were unaware of subjects' assignment to condition. Subjects completed the study within individual cubicles. After a 60-min waiting period to allow acetaminophen to enter the brain during which subjects completed self-report questionnaires and were allowed to rest, subjects completed the trust game. The trust game was administered as a larger social and cognitive assessment (to be reported separately). Subjects were financially compensated. Decisions from subjects in study 1 were presented to participants in study 2 (see below), and one of these decisions was selected randomly to determine each subject's compensation.

In the trust game, subjects were given initial endowments of 4 different sizes and asked to decide how much, if any, of this endowment they wished to send to an anonymous partner. Thus, the subjects in study 1 acted as the investor in the trust game. The amount sent to the partner was multiplied times 4 and subjects were instructed that the partner would decide how much of this new amount to keep for him/herself and how much to return to the subject. After making each investment decision, subjects were then asked how much they expected their partner to return to them. On trials where subjects did not send anything to their partner, they were not asked how much they expected to have returned.

Results were examined using linear mixed effects models fit with the R package lme4. P-values were calculated with the lmerTest package. In all models, a random intercept for subject was included. For each decision, the proportion of the initial endowment that was invested was calculated as well as the proportion of the amount the partner received that the subject expected to have returned. Drug condition was dummy coded. There was no main effect of drug on the proportion invested, b = -0.06 (0.155), t = -0.386, p = 0.7 (see Table 1). However, there was a significant proportion expected returned by drug condition interaction, b = -0.162 (0.067), t = -2.417, p = 0.016. Further examination showed that the relationship between expectations and proportion invested was stronger on placebo (b = 0.302 (0.048), t = 6.258, p < 0.0001) than on acetaminophen (b = 0.14 (0.046), t = 3.018, p = 0.003). This model excluded trials in which the subject did not make an investment because there was expected return reported. However, the results remained the same when assuming that not investing anything corresponded to an expectation of receiving nothing in return. Thus, subjects' expectations were less predictive of the actual amount invested under acetaminophen.

In order to test the hypothesis that the direction of acetaminophen's effects depended on expectations, we divided the trials into three categories: trials in which the subject expected to lose money (i.e., a proportion expected return of less than .25; a negative outcome), trials in which the subject expected to gain money (i.e., a proportion expected return of greater than .25; a positive outcome), and trials in which the subject expected the receive the same amount as was invested (i.e., a proportion expected return of .25; a neutral outcome). We felt justified categorizing our continuous variable in this way for two reasons: (1) it makes explicit what we consider to be positive and negative expectations and thus allows us to test whether

acetaminophen actually produces opposing effects dependent on the valence of the expectations; (2) a rational investor who expects to gain money should always invest more because this would be expected to produce an increased profit and vice versa for an investor who expects to lose money. Thus, while proportion expected return might be continuous, there is also likely to be a categorical structure to the variable's relationship with actual amount invested. The results of this analysis revealed that acetaminophen increased the proportion invested when subjects had negative expectations, b = 0.184 (0.095), t = 1.947, p = 0.053, but decreased the proportion invested when subjects had positive expectations, b = -0.145 (0.084), t = -1.736, p = 0.085 (see Table 2). There was no effect of drug condition when subjects had neutral expectations, b = 0.004 (0.105), t = 0.04, p = 0.968. Thus, acetaminophen's effect on trusting investment behavior was reversed by the valence of the expectations that subjects had.

Study 2

One hundred nineteen undergraduates at The Ohio State University completed the experiment in exchange for course credit. Subjects were randomly assigned to take either an acute dose of 1,000 mg of acetaminophen or a placebo, both in a liquid vehicle (61 acetaminophen). Experimenters and subjects were unaware of subjects' assignment to condition. Subjects completed the study within individual cubicles. After a 60-min waiting period to allow acetaminophen to enter the brain during which subjects completed self-report questionnaires and were allowed to rest, subjects completed the trust and ultimatum games. These economic games were administered as a larger social and cognitive assessment (to be reported separately). Subjects were financially compensated. Decisions from subjects in study 2

were paired with the corresponding subject in study 1, and one of these decisions was selected randomly to determine each subject's compensation.

Subjects completed an ultimatum game in the role of the responder. Subjects were presented with 20 proposals made by subjects in study 1, which were preselected by the experimenters to range from fair (e.g., offering the responder .5 of the money) to unfair (e.g., offering the responder .1 of the money). The proposals were presented to every subject in the same randomized sequence and it was explained to subjects that proposals came from different partners (i.e., one-shot games). Subjects decided whether to accept or reject each proposal. Accepting a proposal meant that the money would be divided as proposed by the proposer while rejecting meant that neither partner would receive anything.

Five subjects were dropped from the ultimatum game analyses for expressing confusion about the task even after reviewing the instructions and passing a quiz over the instructions. A mixed-effects logistic regression was used to predict proposal acceptance from drug condition, proportion of money offered to the responder (i.e., offer fairness), the change in offer fairness relative to the previous trial, and their interactions. Subjects were treated as a random effect with varying intercepts. The 3-way interaction and then the 2-way offer fairness by drug condition interaction were each dropped from the model because they were not significant (b = -0.328 (0.245), z = -1.324, p = 0.18; b = -0.067 (0.305), z = -0.22, p = 0.826; respectively). The final model revealed an interaction between drug condition and the change in offer fairness (b = -0.364 (0.197), z = -1.844, p = 0.065; see Table 3) such that subjects on placebo were more sensitive to changes in offer fairness (b = 0.849 (0.173), z = 4.9, p < 0.0001) than subjects on acetaminophen (b = 0.48 (0.156), z = 3.105, p = 0.002). Thus, acetaminophen reduced how

much shifts in expectations induced by trial-to-trial fluctuations in offer fairness influenced offer acceptance.

Subjects also completed 32 one-shot trials of a trust game in the role of trustee. Investments came from subjects in study 1. On each trial, subjects were first asked how much of the initial endowment they expected their partner to invest. Next, subjects were informed of how much their partner actually chose to invest and this investment was multiplied times 4 (see study 1). Then, subjects were asked how much they thought their partner expected them to return. Finally, subjects were asked how much they would actually return and then were told how much their partner had actually expected.

A linear mixed-effects regression revealed a significant interaction between drug condition and expectations (b = -0.092 (0.032), t = -2.897, p = .004) such that subjects on acetaminophen were less sensitive to perceptions of expectations (b = 0.421 (0.023), t = 18.402, p < .0001) relative to placebo (b = 0.513 (0.022), t = 23.486, p < .0001). Furthermore, this effect was stronger among subjects high in a variety of affective and interpersonal sensitivities (see Tables 5-13).

Figure 1. Trust Game as Investor

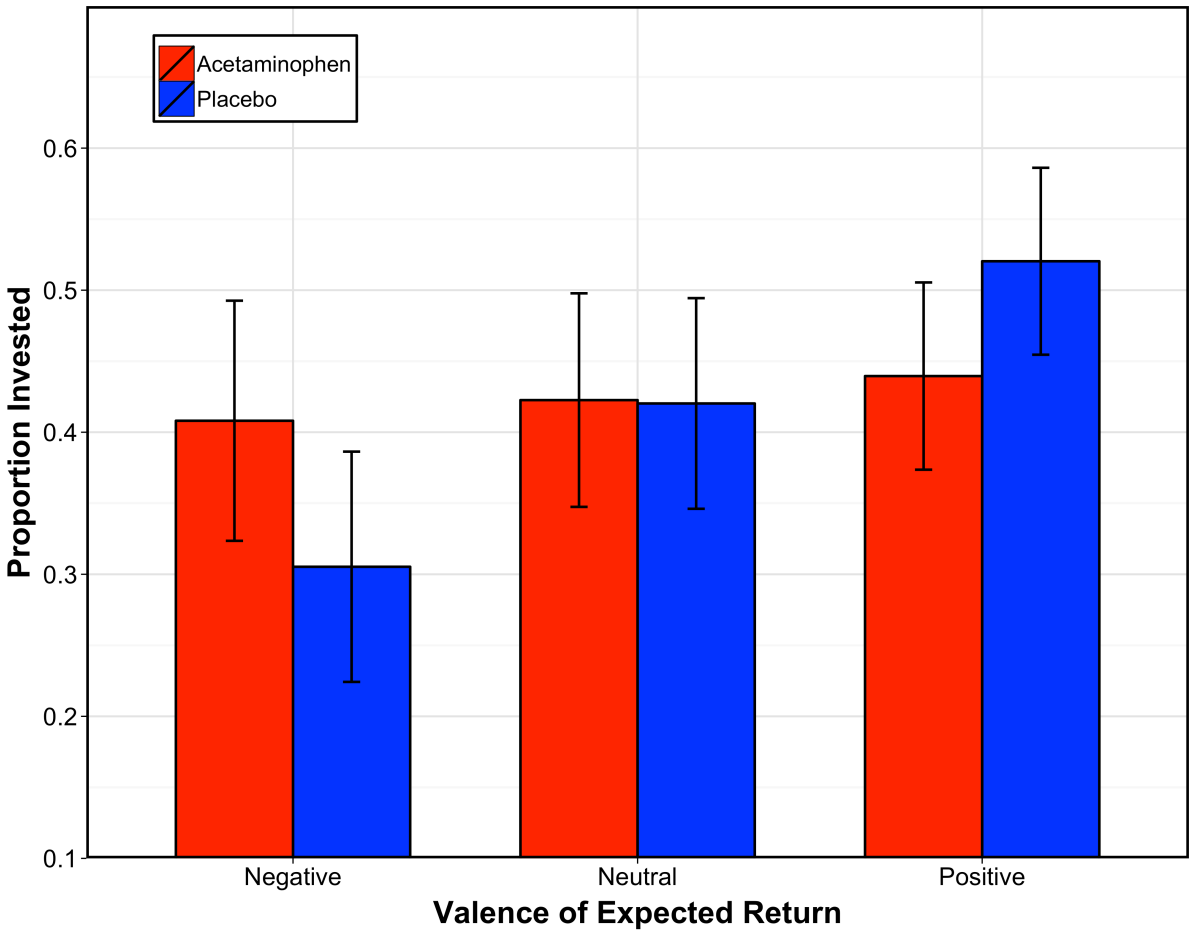

Figure 2. Ultimatum Game as Responder

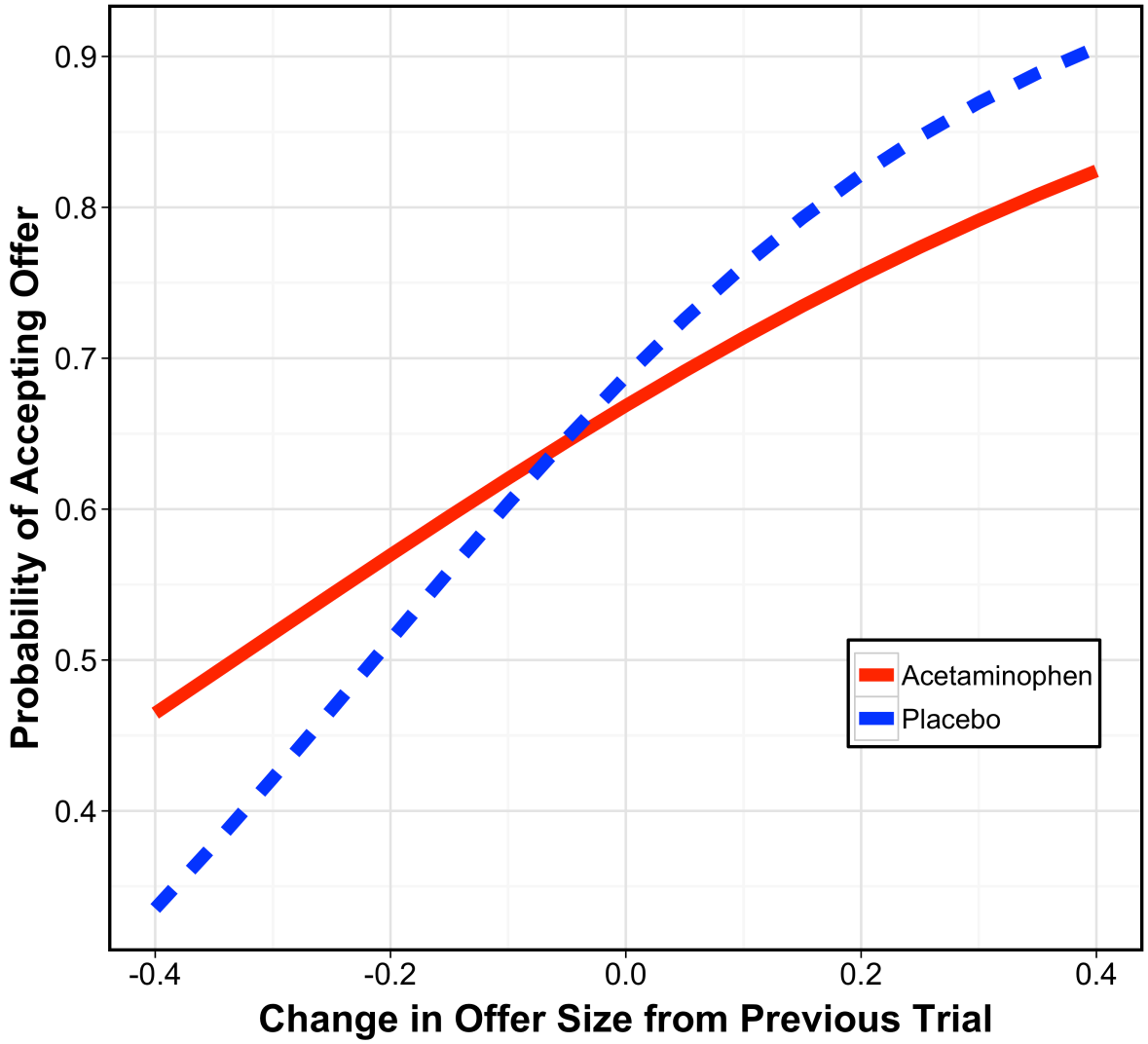

Figure 3. Trust Game as Trustee

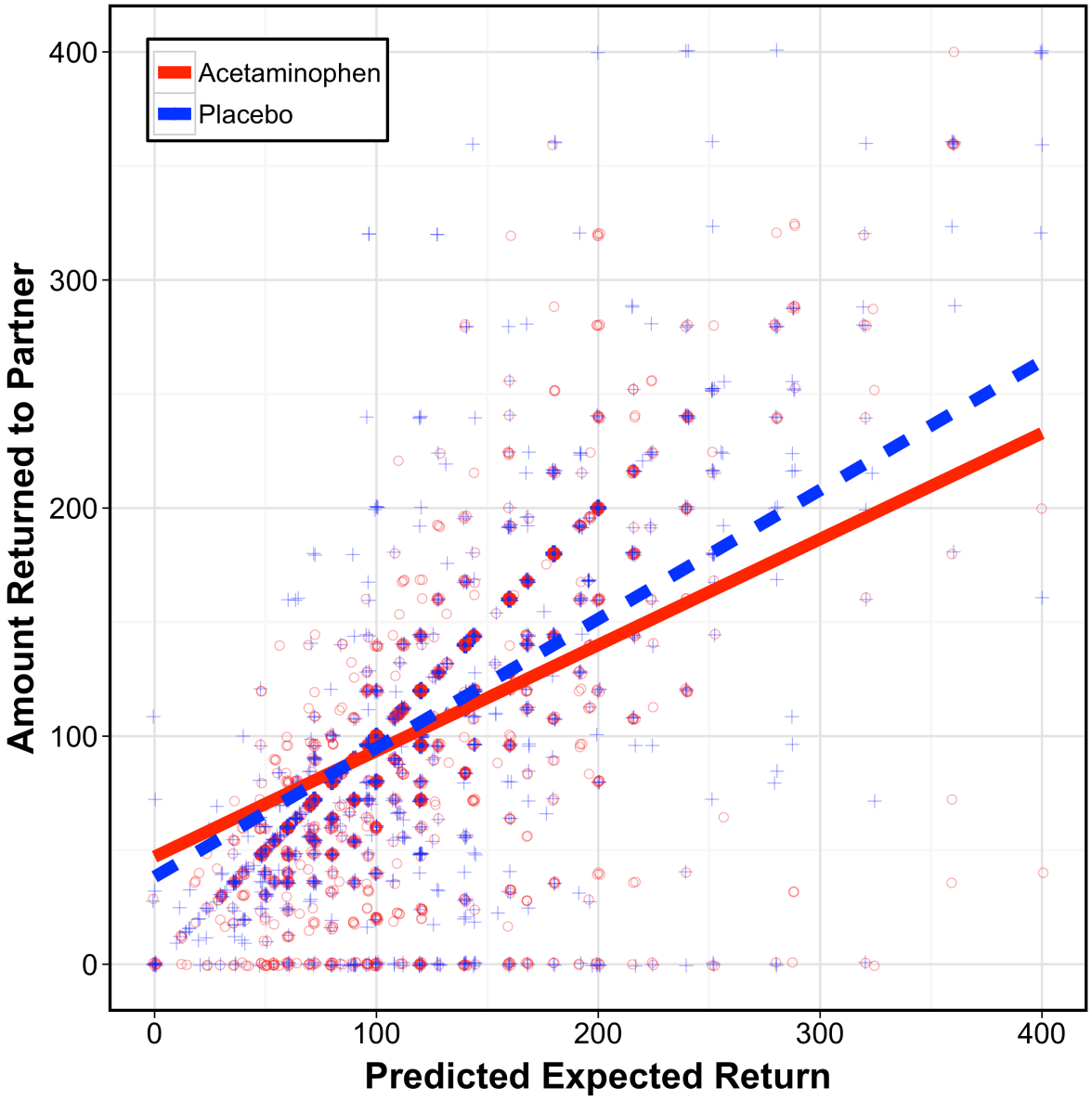

Table 1. Trust Game as Investor

Subjects were treated as a random effect with varying intercepts (s^2 = 0.6597, SD = 0.8122). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.096	0.109	0.886	.378
Expected Return	0.302	0.048	6.258	< .0001
Drug	-0.06	0.155	-0.386	.7
Drug * Expected Return	-0.162	0.067	-2.417	.016

Table 2. Trust Game as Investor (contrasts)

Subjects were treated as a random effect with varying intercepts (s^2 = 0.6912, SD = 0.8314). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	-0.001	0.081	-0.01	.992
Neg_Acetaminophen vs. Neg_Placebo	0.184	0.095	1.947	.053
Neu_Acetaminophen vs. Neu_Placebo	0.004	0.105	0.04	.968
Pos_Acetaminophen vs. Pos_Placebo	-0.145	0.084	-1.736	.085
Neg_Expectations vs. Neu_Expectations	-0.225	0.048	-4.707	< .0001
Pos_Expectations vs. Neu_Expectations	0.217	0.045	4.845	< .0001

Table 3. Ultimatum Game

Subjects were treated as a random effect with varying intercepts (s^2 = 6.931, SD = 2.633). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	z - Value	p - Value
Intercept	0.790	0.382	2.068	.039
Proposal Fairness	2.329	0.167	13.952	< .0001
Drug	-0.088	0.521	-0.169	.866
Change in Fairness	0.849	0.173	4.9	< .0001
Proposal Fairness * Change in Fairness	0.648	0.122	5.297	< .0001
Drug * Change in Fairness	-0.364	0.197	-1.844	.065

Table 4. Trust Game as Trustee

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1976, SD = 0.4445). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.028	0.06	28.118	< .0001
Offer Amount	0.24	0.022	11.135	< .0001
Predicted Expected Return	0.513	0.022	23.486	< .0001
Drug	-0.056	0.083	-0.666	.507
Drug * Offer Amount	0.059	0.031	1.95	.051
Drug * Predicted Expected Return	-0.092	0.032	-2.897	.004

Table 5. IRI Empathic Concern

Subjects were treated as a random effect with varying intercepts (s^2 = 0.2002, SD = 0.4474). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.032	0.061	0.526	.600
Offer Amount	0.242	0.022	11.116	< .0001
Predicted Expected Return	0.51	0.022	23.051	< .0001
IRI Empathic Concern	0.04	0.057	0.704	.483
Drug	-0.067	0.085	-0.792	.43
Drug * Offer Amount	0.063	0.031	2.051	.04
Predicted Expected Return * IRI Empathic Concern	0.062	0.012	5.134	< .0001
Drug * Predicted Expected Return	-0.1	0.032	-3.101	.002
Drug * IRI Empathic Concern	-0.016	0.085	-0.184	.854
Drug * Predicted Expected Return * IRI Empathic Concern	-0.077	0.018	-4.216	< .0001

Table 6. IRI Perspective Taking

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1964, SD = 0.4432). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.033	0.060	0.547	.586
Offer Amount	0.239	0.022	10.852	< .0001
Predicted Expected Return	0.513	0.023	22.747	< .0001
IRI Perspective Taking	-0.017	0.061	-0.276	.783
Drug	-0.059	0.084	-0.694	.489
Drug * Offer Amount	0.068	0.031	2.174	.03
Predicted Expected Return * IRI Perspective Taking	0.008	0.013	0.58	.562
Drug * Predicted Expected Return	-0.103	0.033	-3.173	.002
Drug * IRI Perspective Taking	0.123	0.084	1.463	.146
Drug * Predicted Expected Return * IRI Perspective Taking	-0.002	0.019	-0.095	.925

Table 7. IRI Personal Distress

Subjects were treated as a random effect with varying intercepts (s^2 = 0.2008, SD = 0.4481). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.032	0.061	0.533	.595
Offer Amount	0.239	0.022	10.965	< .0001
Predicted Expected Return	0.514	0.022	23.262	< .0001
IRI Personal Distress	0.043	0.069	0.62	.536
Drug	-0.067	0.085	-0.792	.43
Drug * Offer Amount	0.062	0.031	1.985	.047
Predicted Expected Return * IRI Personal Distress	0.055	0.016	3.478	.001
Drug * Predicted Expected Return	-0.096	0.032	-2.985	.003
Drug * IRI Personal Distress	-0.043	0.088	-0.494	.622
Drug * Predicted Expected Return * IRI Personal Distress	-0.09	0.02	-4.532	< .0001

Table 8. GASP Negative Behavior Evaluation (NBE)

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1991, SD = 0.4462). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.029	0.06	0.479	.633
Offer Amount	0.242	0.022	11.24	< .0001
Predicted Expected Return	0.511	0.022	23.483	< .0001
GASP NBE	0.044	0.052	0.856	.394
Drug	-0.057	0.084	-0.681	.497
Drug * Offer Amount	0.06	0.03	1.958	.05
Predicted Expected Return * GASP NBE	0.054	0.011	4.85	< .0001
Drug * Predicted Expected Return	-0.093	0.032	-2.937	.003
Drug * GASP NBE	-0.031	0.088	-0.348	.728
Drug * Predicted Expected Return * GASP NBE	-0.034	0.02	-1.684	.092

Table 9. GASP Repair

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1974, SD = 0.4443). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.033	0.06	0.554	.581
Offer Amount	0.241	0.022	11.203	< .0001
Predicted Expected Return	0.518	0.022	23.764	< .0001
GASP Repair	0.055	0.056	0.982	.328
Drug	-0.064	0.083	-0.765	.446
Drug * Offer Amount	0.057	0.03	1.876	.061
Predicted Expected Return * GASP Repair	0.058	0.012	4.917	< .0001
Drug * Predicted Expected Return	-0.096	0.032	-3.046	.002
Drug * GASP Repair	0.000	0.084	0.005	.996
Drug * Predicted Expected Return * GASP Repair	-0.034	0.018	-1.898	.058

Table 10. GASP Negative Self Evaluation (NSE)

Subjects were treated as a random effect with varying intercepts (s^2 = 0.2, SD = 0.4472). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.029	0.06	0.481	.631
Offer Amount	0.238	0.021	11.073	< .0001
Predicted Expected Return	0.517	0.022	23.804	< .0001
GASP NSE	0.039	0.053	0.728	.468
Drug	-0.057	0.084	-0.675	.501
Drug * Offer Amount	0.062	0.03	2.034	.042
Predicted Expected Return * GASP NSE	0.07	0.011	6.547	< .0001
Drug * Predicted Expected Return	-0.096	0.032	-3.02	.003
Drug * GASP NSE	0.011	0.086	0.125	.901
Drug * Predicted Expected Return * GASP NSE	-0.074	0.02	-3.745	< .0001

Table 11. GASP Withdraw

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1999, SD = 0.4471). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.027	0.06	0.442	.659
Offer Amount	0.239	0.022	11.077	< .0001
Predicted Expected Return	0.516	0.022	23.5	< .0001
GASP Withdraw	0.023	0.06	0.377	.707
Drug	-0.052	0.084	-0.62	.537
Drug * Offer Amount	0.057	0.031	1.877	.061
Predicted Expected Return * GASP Withdraw	-0.017	0.013	-1.37	.171
Drug * Predicted Expected Return	-0.092	0.032	-2.882	.004
Drug * GASP Withdraw	-0.007	0.084	-0.083	.934
Drug * Predicted Expected Return * GASP Withdraw	-0.004	0.018	-0.215	.829

Table 12. Need To Belong (NTB)

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1928, SD = 0.4391). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.007	0.06	0.124	.901
Offer Amount	0.235	0.021	10.956	< .0001
Predicted Expected Return	0.499	0.022	22.907	< .0001
NTB	0.104	0.065	1.598	.113
Drug	-0.057	0.084	-0.675	.501
Drug * Offer Amount	0.07	0.031	2.297	.022
Predicted Expected Return * NTB	0.098	0.014	6.814	< .0001
Drug * Predicted Expected Return	-0.097	0.032	-3.042	.002
Drug * NTB	-0.183	0.085	-2.15	.034
Drug * Predicted Expected Return * NTB	-0.16	0.02	-8.137	< .0001

Table 13. Rejection Sensitivity Questionnaire (RSQ)

Subjects were treated as a random effect with varying intercepts (s^2 = 0.1723, SD = 0.4151). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.038	0.058	0.652	.516
Offer Amount	0.275	0.022	12.284	< .0001
Predicted Expected Return	0.477	0.023	20.939	< .0001
RSQ	0.022	0.055	0.406	.685
Drug	-0.06	0.082	-0.733	.465
Drug * Offer Amount	0.024	0.032	0.752	.452
Predicted Expected Return * RSQ	0.029	0.011	2.66	.008
Drug * Predicted Expected Return	-0.058	0.033	-1.757	.079
Drug * RSQ	-0.038	0.082	-0.466	.643
Drug * Predicted Expected Return * RSQ	-0.094	0.017	-5.433	< .0001

Table 14. Counterfactual Guilt

Subjects were treated as a random effect with varying intercepts (s^2 = 0.4046, SD = 0.6361). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.043	0.09	0.478	.634
Amount Returned	-0.184	0.037	-4.947	< .0001
Counterfactual Deviation	0.531	0.048	11.033	< .0001
Drug	0.145	0.124	1.166	.246
Amount Returned * Counterfactual Deviation	-0.152	0.019	-8.182	< .0001
Drug * Counterfactual Deviation	-0.085	0.048	-1.786	.075

Table 15. Counterfactual Guilt & GASP Negative Behavior Evaluation (NBE)

Subjects were treated as a random effect with varying intercepts (s^2 = 0.4046, SD = 0.6361). All continuous variables were standardized.

Predictor	Parameter Estimate	SE	t - Value	p - Value
Intercept	0.046	0.083	0.555	.58
Amount Returned	-0.185	0.038	-4.93	< .0001
Counterfactual Deviation	0.524	0.048	10.842	< .0001
Drug	0.147	0.115	1.278	.204
GASP NBE	0.259	0.058	4.506	< .0001
Amount Returned * Counterfactual Deviation	-0.157	0.019	-8.408	< .0001
Amount Returned * GASP NBE	-0.036	0.041	-0.87	.385
Counterfactual Deviation * GASP NBE	0.098	0.044	2.214	.027
Drug * Counterfactual Deviation	-0.067	0.048	-1.389	.165
Drug * Counterfactual Deviation * GASP NBE	-0.116	0.053	-2.193	.029

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